ITEM OF FOOTWEAR WHICH HAS LIMITED ROTATIONAL MOVEMENT AND WHICH IS DAMPED AT THE END OF TRAVEL

The present invention relates to an item of footwear which is intended for sporting use.

It is particularly suitable for protecting a user who is participating in motor sports and more particularly motorcycling. However, it may also be found to be advantageous for use in snowboarding, mounting biking, jet-skiing or hiking, in particular.

WO-A-01 35781 describes an item of footwear of this type, and more particularly a motorcycle boot comprising:

- a first rigid shell which defines a body which is intended to receive the foot of a user and which extends in an extension direction,
- a second rigid shell which defines an upper which is intended to receive the leg of the user and which extends substantially in an upright direction,
- an articulation which connects the body and the upper, said articulation allowing the upper to rotate relative to the body in a transverse direction which is substantially perpendicular to the extension direction and the upright direction, in order to allow flexion of the foot of the user,
- stop means comprising a first element which is connected to the body and a second element which is connected to the upper, one coming into contact with the other in order to limit the rotation of the upper relative to the body in the transverse direction within a maximum rotation range,

- damping means which produce a couple in the transverse direction opposing the moving together of the first and second stop elements.

That item has been found to be strong and protects the user effectively. However, it is sometimes desirable to provide a simpler, lighter item which affords greater comfort in use.

Furthermore, US-A-5 909 885 describes a roller boot which is provided with an energisation device which differs from WO-A-01 35781 in that

- the stop means comprise:
  - first stop means which comprise a first element which is connected to the body and a second element which is connected to the upper, one coming into contact with the other in order to limit the rotation of the upper relative to the body in the transverse direction in a first rotation direction,
  - second stop means which comprise a first element which is connected to the body and a second element which is connected to the upper, one coming into contact with the other in order to limit the rotation of the upper relative to the body in the transverse direction in a second rotation direction counter to the first rotation direction,

- the damping means comprise:
  - first damping means which produce a couple in the transverse direction opposing the moving together of the first and second stop elements of the first stop means, and
  - second damping means which produce a couple in the transverse direction opposing the moving together of

the first and second stop elements of the second stop means.

However, those features are intended to improve the efficacy of the skating and not the protection of the lower leg, in particular the ankle, of the user.

So that the item of footwear is comfortable whilst at the same time protecting the user effectively against any risk of injury, in accordance with the invention the maximum rotation range in the transverse direction extends over from 50 degrees to 70 degrees and the normal rotation range in the transverse direction extends over from 30 degrees to 50 degrees and is substantially centred relative to the maximum rotation range.

In this manner, the normal rotation range is extended enough for the user to be able to freely flex his ankle during normal use of the item of footwear. Although the remainder of the "angular travel" for stopping the rotational movement progressively before the risk of injury and the arrival at abutment may be reduced, it is found to be sufficient for a given number of sports which do not require extreme protection.

Advantageously, the damping means comprise a thin flexible plate which has a first end which is connected to one of the two shells and a second end which moves freely within the normal rotation range and which comes into abutment with the other shell between the normal rotation range and the maximum rotation range.

This construction is simple and provides good strength at moderate cost.

In accordance with another feature of the invention, the thin flexible plate is connected to said shell near the articulation. This construction provides the user with a high level of comfort.

The thin flexible plate preferably has a curved portion which extends around the articulation, which allows the thin flexible plate to be readily connected to the shell.

The invention will be appreciated even more clearly from the following description given with reference to the appended drawings, in which:

- Figure 1 shows a motorcycle boot in accordance with the invention in a rest position,
- Figure 2 shows the boot of Figure 1 in a flexion position,
- Figure 3 shows the boot of Figure 1 in an extension position,
- Figure 4 is a partial cross-section along the arrow indicated IV-IV in Figure 1 in a rest position,
- Figure 5 is a perspective view of a damping element according to the invention,
- Figure 6 shows a variant of the boot according to the invention.

Figures 1 to 4 illustrate a boot 1 comprising a body 2 which is intended to receive the foot of a user in the lower portion, an upper 4 which is intended to receive the leg of a user in the upper portion, an inner lining 3 which extends inside the upper 4 and the body 2, an articulation device 6 which connects the upper 4 to the body 2 in the intermediate portion, stop means 32, 34 and damping means 14.

The inner lining 3 is relatively flexible. It is advantageously produced, during conventional shoemaking, from leather or synthetic material and provides the user with comfort. The body 2 and the upper 4 in conjunction with the articulation device 6 ensure the protection of the user. The body 2 and the upper 4 each comprise a relatively rigid shell, which is advantageously produced from plastics material and which is intended to protect the lower limbs of the user. Those shells can be perforated locally. The body extends in an extension direction 8 which is substantially horizontal when the user places his foot on a horizontal surface whilst the upper extends in an upright direction 10 which is substantially vertical.

The extension direction 8 and the upright direction 10 define a centre plane P which is parallel with the plane of illustration of Figures 1 to 3. The boot 1 further has a transverse direction 12 which extends substantially perpendicularly to the extension direction 8 and the upright direction 10.

The articulation device 6 brings about the rotation of the upper 4 relative to the body 2 in the transverse direction 12. It comprises two articulation pivots 24, 26 which are arranged substantially symmetrically relative to the plane P and which extend in the transverse direction 12 through the body 2 and the upper 4.

The stop means 32, 34 comprise flexion stop means 32 and extension stop means 34. The flexion stop means 32 and the extension stop means 34 each comprise a first portion 32a, 34a which is connected to the body and a second portion 32b, 34b which is connected to the upper 4, said first and second portions of the flexion and extension stop means coming into

abutment with each other in order to stop the rotation of the upper 4 relative to the body 2 in the transverse direction 12 in terms of flexion and extension, respectively.

The damping means 14 are constituted by two thin resiliently deformable plates 16, 18 which are connected to the upper 4 and which each move inside a housing 28 which is provided in the body 2 and which is delimited by a flexion stop surface 20, a pronation/supination stop surface 21 and an extension stop surface 22. The housings 28 and in particular the flexion stop surface 20, pronation/supination stop surface 21 and extension stop surface 22 thereof are arranged substantially symmetrically relative to the plane P.

The two thin deformable plates 16, 18 are integrated in a unitary damping element 30 which is of resiliently deformable material and which further comprises a connection element 36 which retains said thin deformable plates relative to the upper 4. The damping element 30 is also substantially symmetrical relative to the centre plane P.

The thin deformable plates 16 extend in the direction of the articulation axis and substantially in the upright direction. They each comprise a free end 16a, 18a and an end 16b, 18b which is connected to the connection element 36. The connection element 36 is substantially U-shaped comprising two branches 40a, 40b which extend substantially in the extension direction 8 and which are connected to each other by a base 42 which extends substantially in the transverse direction 12. The base 42 includes a retention stud 38 which is introduced in the upper 4 in the extension direction 8, whilst the branches 40a, 40b each terminate in a curved portion 44a, 44b which is substantially circular

and which extends in the transverse direction 12 around the pivots 24, 26, under the enlarged head of said pivots 24, 26. The connection element 36 and the end 16b, 18b of the thin flexible plates which are connected to the curved portions 44a, 44b are thus completely retained relative to the upper 4 by means of the curved portions 44a, 44b and the retention stud 38. Furthermore, the damping element 30 can readily be disassembled and replaced by the curved portions 44a, 44b being deformed. In order to prevent inadvertent disassembly and in order to protect it, the thin plates 16, 18 are advantageously retained in the housings 28 behind a cover (not illustrated).

As illustrated in Figures 1 and 2, in the event of a flexion movement of the ankle of a user about the transverse direction 12, the upper 4 pivots about the pivots 24, 26, the thin plates 16, 18 move freely in the housings 28 until the free end 16a, 18a of the thin plates 16, 18 come into contact with the flexion stop surfaces 20 of the housings 28. The thin plates 16, 18 then become deformed progressively in terms of flexion in the transverse direction 12 until the two portions 32a, 32b of the flexion stop means 32 come into contact with each other.

As indicated in Figure 2, the magnitude α_1 of the free flexion movement allowed by the articulation device 6, without any deformation of the thin flexible plates 16, 18, is approximately 20 degrees relative to the initial position illustrated in Figure 1. Subsequently, over a maximum flexion magnitude of approximately 5 additional degrees, the thin flexible plates 16, 18, becoming deformed in terms of flexion, oppose the continuation of the flexion movement and thus damp any impact against the flexion stop means 32.

Conversely, as illustrated in Figures 1 and 3, during an extension movement of the ankle of a user about the transverse direction 12, the upper 4 pivots about the pivots 24, 26, the thin plates 16, 18 move freely in the housings 28 until the free end 16a, 18a of the thin plates 16, 18 come into contact with the extension stop surfaces 22 of the housings 28. The thin plates 16, 18 then become deformed progressively in terms of flexion in the transverse direction 12 until the two portions 34a, 34b of the extension stop means 34 come into contact with each other.

As indicated in Figure 3, the magnitude α_2 of the free extension movement allowed by the articulation device 6 is approximately 25 degrees relative to the initial position illustrated in Figure 1. Subsequently, over a maximum extension magnitude of approximately 5 additional degrees, the thin flexible plates 16, 18, becoming deformed in terms of flexion, oppose the continuation of the extension movement and thus damp any impact against the extension stop means 34.

The extent of normal rotation allowing the user to move his ankle without any effort in the transverse direction 12 is therefore substantially 45 degrees. It is advantageously from 30 to 50 degrees, whilst the extent of maximum rotation between the stop position against the flexion stop means 32 and the stop position against the extension stop means 34 is substantially centred relative to the normal rotation and is advantageously from 50 degrees to 70 degrees. Furthermore, the thin flexible plates 16, 18 advantageously act over a rotation range of from 5 degrees to 20 degrees, both during the flexion movement and during the extension movement of the ankle.

Furthermore, the construction illustrated in Figures 1 to 4 allows the upper 4 to rotate relative to the body 2 in the extension direction 8 in order to allow pronation/supination of the ankle. For this purpose, as illustrated in Figure 4 (the partial cross-section not illustrated is substantially symmetrical), the passages 46 which are provided in the body 2 and through which the pivots extend are of oblong form and extend in the upright direction 10. Slight translation movements in the upright direction 10 between the upper 4 and the body 2 are also possible in order to follow the movement of the malleolus of the user.

In the event of a pronation/supination movement of the ankle of a user about the extension direction 8, the pivots 24, 26 slide freely in the oblong holes 46 until the free end 16a, 18a of the thin plates 16, 18 come into contact with the pronation/supination stop surfaces 21 of the housings 28. The thin plates 16, 18 are then progressively compressed in order to damp the movement until the pivots 24, 26 reach a stop position in the oblong holes 46.

The magnitude of each of the free pronation and supination movements is approximately 10 degrees (that is to say, a free pronation/supination magnitude of approximately 20 degrees) and it is further advantageously possible to carry out a rotation in the extension direction of approximately 5 degrees before reaching the stop position in that articulation direction.

Figure 6 illustrates a boot 1' which substantially differs from the construction illustrated in Figures 1 to 4 in that the upper 4 can pivot only in the transverse direction and in that it comprises only a single thin flexible plate 16'.

The absence of translation and rotation in the upright direction 10 and rotation in the extension direction 8 is because circular holes are provided in place of oblong holes in the body 2, through which holes the pivots 24 extend.

It is not necessary to provide a second thin flexible plate since the thin flexible plate 16' has adequate characteristics.